International Journal of Modern Physics A
Vol. 20, No. 17 (2005) 4035–4054
© World Scientific Publishing Company

World Scientific
www.worldscientific.com

B_c AND HEAVY MESON SPECTROSCOPY IN THE LOCAL APPROXIMATION OF THE SCHRÖDINGER EQUATION WITH RELATIVISTIC KINEMATICS

SAMEER M. IKHDAIR* and RAMAZAN SEVER†

Department of Electrical and Electronics Engineering,
Near East University, Nicosia, North Cyprus, Mersin 10, Turkey
and
Department of Physics, Middle East Technical University, Ankara, Turkey
**sameer@neu.edu.tr*
†*sever@metu.edu.tr*

Received 29 March 2004

We present bound state masses of the self-conjugate and non-self-conjugate mesons in the context of the Schrödinger equation taking into account the relativistic kinematics and the quark spins. We apply the usual interaction by adding the spin dependent correction. The hyperfine splittings for the 2S charmonium and 1S bottomonium are calculated. The pseudoscalar and vector decay constants of the B_c meson and the unperturbed radial wave function at the origin are also calculated. We have obtained a local equation with a complete relativistic corrections to a class of three attractive static interaction potentials of the general form $V(r) = -Ar^{-\beta} + \kappa r^{\beta} + V_0$, with $\beta = 1,\ 1/2,\ 3/4$ which can also be decomposed into scalar and vector parts in the form $V_V(r) = -Ar^{-\beta} + (1-\epsilon)\kappa r^{\beta}$ and $V_S(r) = \epsilon\kappa r^{\beta} + V_0$; where $0 \leq \epsilon \leq 1$. The energy eigenvalues are carried out up to the third order approximation using the shifted large-N-expansion technique.

Keywords: B_c meson; spin correction; potential model; heavy quarkonium.

PACS numbers: 03.65.Ge, 12.39.Jh, 13.30.Gd

1. Introduction

Theoretical interest has risen in the study of the spectroscopy of B_c meson in the framework of heavy quarkonium theory.[1] Moreover, the discovery of the B_c (the lowest pseudoscalar $^1S_0$ state) was reported in 1998 by the Collider Detector at Fermilab (CDF) collaboration in 1.8 TeV $p - \bar{p}$ collisions at the Fermilab[2] with an observed mass $M_{B_c} = 6.40 \pm 0.39 \pm 0.13$ GeV has inspired new theoretical interest in the subject.[3–6] Further, Kwong and Rosner[7] predicted the masses of the lowest vector (triplet) and pseudoscalar (singlet) states of the B_c systems using an empirical mass formula and a logarithmic potential. Eichten and Quigg[1] calculated the energies and decays of the B_c system that was based on the QCD-motivated